REMARKS

The Specification has been amended to correct informalities contained therein. Claim 1 has been amended. Claim 2 has been canceled. Claims 27 and 28 have been added. Therefore, claims 1 and 3-28 are pending in the case. Entrance of the amendments and further examination and reconsideration of pending claims 1 and 3-28 are respectfully requested.

Section 103 Rejections

Claims 1, 3-6, 9, 10, 14, 15, and 17 were rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 6,701,004 to Shykind et al. (hereinafter "Shykind") in view of U.S. Patent No. 5,932,377 to Ferguson et al. (hereinafter "Ferguson"). Claims 7, 16, 20-21, and 23-26 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Shykind in view of Ferguson and further in view of "Critical Area Extraction for Soft Fault Estimation" by Allan et al. (hereinafter "Allan"). Claims 2, 18, and 19 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Shykind in view of Ferguson and further in view of U.S. Patent No. 5,046,109 to Fujimori et al. (hereinafter "Fujimori"). Claim 22 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Shykind in view of Ferguson and Allan and further in view of Fujimori. Claim 8 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Shykind in view of Ferguson in view of U.S. Patent No. 7,133,548 to Kenan et al. (hereinafter "Kenan"). Claim 11 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Shykind in view of Ferguson and further in view of U.S. Patent No. 5,444,480 to Sumita (hereinafter "Sumita"). Claims 12 and 13 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Shykind in view of Ferguson and further in view of U.S. Patent Application Publication No. 2002/0181756 to Shibuya et al. (hereinafter "Shibuya"). Claim 2 has been canceled thereby rendering its rejection moot. As will be set forth in more detail below, the § 103(a) rejections of claims 1 and 3-26 are respectfully traversed.

To establish *prima facie* obviousness of a claimed invention, all claim limitations must be taught or suggested by the prior art. *In re Royka*, 490 F.2d 981, 180 U.S.P.Q. 580 (C.C.P.A. 1974), MPEP 2143.03. Obviousness cannot be established by combining or modifying the teachings of the prior art to produce the claimed invention, absent some teaching or suggestion or incentive to do so. *In re Bond*, 910 F.2d 81, 834, 15 USPQ2d 1566, 1568 (Fed. Cir. 1990). The cited art does not teach or suggest all limitations of the currently pending claims, some distinctive limitations of which are set forth in more detail below.

The cited art does not teach or suggest determining a presence of an anomaly in a design pattern of a reticle by comparing at least one pair of aerial images corresponding to at least two different values of a member of a set of lithographic variables for which the aerial images are acquired, one value of which represents a reference member value. Amended independent claim 1 recites:

> A method, comprising: acquiring aerial images of a reticle containing a design pattern, wherein the aerial images are acquired for different values of a member of a set of lithographic variables, and wherein one of the different values represents a reference member value; and determining a presence of an anomaly in the design pattern by comparing at least one pair of the aerial images corresponding to at least two of the different values, wherein one of the at least two of the different values represents the reference member value.

Support for the amendments to claim 1 can be found in the claims as originally filed, for example, in claim 2 as originally filed.

The Office Action states:

> Shykind et al (as modified by Ferguson et al) does not disclose expressly one of the different values represents a reference member value. Fujimori et al discloses the use of reference data, DR, the reference member value that is used to compare to another input data (col. 3, lines 52-65), which is paralleled to the other value of Shykind et al by use of comparison between two pieces of data. (Office Action -- pages 8-9).

Applicants respectfully traverse this assertion. In particular, Fujimori states:

> A computer 22 is adapted for reading, from an external memory device, reference data corresponding to a small region of the real pattern image picked-up by the image pick-up device 14, and delivers this data to a pattern modifying circuit (transformer) 26. The pattern modifying circuit 26 is adapted for processing the reference data from the computer 22 such as to enlarge or contract the reference pattern represented by the reference data, and sends the processed reference data DR to inspection circuit 20. The inspection circuit 20 is adapted for comparing the image data DI and the reference data DR which are delivered thereto in a time-sequential synchronized manner. If there is any difference between both data indicative of any defect in the real pattern, the inspection circuit 20 delivers defect data DD to the computer 22. (Fujimori -- col. 3, lines 31-47).

Therefore, Fujimori discloses comparing image data for an object to reference data to determine if there are defects on the object. However, Fujimori does not teach or suggest that the reference data is an aerial image of the object acquired at a value of a member of a set of lithographic variables that represents a reference member value. Therefore, Fujimori does not teach or suggest determining a presence of an anomaly in a design pattern of a reticle by comparing at least one pair of aerial images corresponding to at least two different values of a member of a set of lithographic variables for which the aerial images are acquired, one value of which represents a reference member value, as recited in claim 1, and cannot be combined with Shykind and Ferguson as suggested in the Office Action to overcome deficiencies contained therein.

Furthermore, none of the other cited art (i.e., Allan, Kenan, Sumita, and Shibuya) teaches or suggests determining a presence of an anomaly in a design pattern of a reticle by comparing at least one pair of aerial images corresponding to at least two different values of a member of a set of lithographic variables for which the aerial images are acquired, one value of which represents a reference member value, as recited in claim 1. Therefore, none of the cited art, individually or in any combination thereof, teaches or suggests all limitations of claim 1.

The cited art does not teach or suggest acquiring aerial images of a reticle containing a design pattern, comparing at least one pair of the aerial images corresponding to at least two different values of a member of a set of lithographic variables, and determining an area on the reticle where a lithography process using the reticle is most susceptible to failure based on results of the comparing step. Independent claim 17 recites:

> A method, comprising: acquiring aerial images of a reticle containing a design pattern, wherein the aerial images are acquired for different values of a member of a set of lithographic variables; comparing at least one pair of the aerial images corresponding to at least two of the different values; and determining an area on the reticle where a lithography process using the reticle is most susceptible to failure based on results of said comparing.

The Office Action states that "Regarding claim 17, Shykind et al discloses...determining an area on the reticle where a lithography process using the reticle is most susceptible to failure based on results of said comparing by determining the defect area, since a defect area is where the reticle is most susceptible to failure." (Office Action -- page 5). Applicants respectfully traverse this assertion. In particular, Shykind states that "The comparison circuit 210 takes the patterns printed on several sets of dice with different conditions and compares them. The identification mechanism 212 identifies features that display different patterns for same area under different process conditions. The sorter 214 then sorts the identified features to detect and flag mask defects." (Shykind -- col. 2, lines 32-37). Therefore, Shykind discloses detecting and flagging mask defects. Shykind also states that "The different conditions, such as a length of exposure time and an optical focus condition, are configured to highlight and detect defect areas." (Shykind -- col. 1, lines 41-43). Therefore, Shykind does disclose detecting defect areas on a mask. However, different defects on a mask in different areas on the mask will cause a lithography process using the mask to have different susceptibilities to failure. In addition, although Shykind discloses detecting defect areas on a mask, Shykind does not teach or suggest determining which of the defect areas will cause a lithography process using the mask to be most susceptible to failure. Therefore, contrary to the assertions in the Office Action, Shykind does not teach or suggest determining an area on a reticle where a lithography process using the reticle

is most susceptible to failure. As such, contrary to the assertions in the Office Action, the combination of Shykind and Ferguson does not teach or suggest acquiring aerial images of a reticle containing a design pattern, comparing at least one pair of the aerial images corresponding to at least two different values of a member of a set of lithographic variables, and determining an area on the reticle where a lithography process using the reticle is most susceptible to failure based on results of the comparing step, as recited in claim 17.

Furthermore, none of the other cited art (i.e., Allan, Fujimori, Kenan, Sumita, and Shibuya) teaches or suggests acquiring aerial images of a reticle containing a design pattern, comparing at least one pair of the aerial images corresponding to at least two different values of a member of a set of lithographic variables, and determining an area on the reticle where a lithography process using the reticle is most susceptible to failure based on results of the comparing step, as recited in claim 17. Therefore, none of the cited art, individually or in any combination thereof, teaches or suggests all limitations of claim 17.

The cited art does not teach or suggest determining a presence of transient repeating defects on a reticle by subtracting non-transient defects from aerial images of the reticle and comparing at least one pair of the aerial images corresponding to at least two different values of a member of a set of lithographic variables. Independent claim 20 recites:

> A method, comprising: inspecting a reticle containing a design pattern for non-transient defects; acquiring aerial images of the reticle for different values of a member of a set of lithographic variables; and determining a presence of transient repeating defects on the reticle by subtracting the non-transient defects from the aerial images and comparing at least one pair of the aerial images corresponding to at least two of the different values.

The Office Action states:

> Regarding claim 20,...Shykind et al (as modified by Ferguson et al) does not disclose expressly that non-transient defects are found and determining a presence of transient repeating defects on the reticle by subtracting the non-transient defects

> from the aerial images. Allan et al discloses finding hard and soft faults, which is equivalent to transient and non-transient defects, in an integrated circuit from a mask (abstract) and determining the soft faults by subtracting out the hard faults (pg. 3, paragraph 2). (Office Action -- pages 6-7).

Applicants respectfully traverse this assertion. First, Allan does not teach or suggest finding faults in an integrated circuit from a mask as suggested in the Office Action. In particular, Allan states that "Algorithms are presented for extracting the critical area associated with extra and missing material soft faults of an integrated circuit from the mask layout." (Allan -- abstract). Allan also states that "Methods to extract the critical area of soft faults from integrated circuit mask layout have been presented...The tool has the added advantage that it can be interfaced to the Cadence layout editor [35] to allow interactive examination of device layout." (Allan -- conclusion). As such, Allan teaches detecting areas associated with faults in a layout for an integrated circuit using a layout for a mask. However, as is known in the art, a mask layout is different than a physical mask. Therefore, Allan discloses extracting critical areas associated with soft faults in an integrated circuit layout from a mask layout for the integrated circuit, but Allan does not disclose finding hard and soft faults in an integrated circuit from a mask as suggested in the Office Action.

Second, contrary to the assertions in the Office Action, the hard and soft faults disclosed by Allan are not equivalent to transient and non-transient defects as presently claimed. In particular, Allan states:

> Extra material defects cause circuit faults which can be classified as one of two types [2]: Hard Faults: These are faults which cause a short between two separate electrical nodes as shown in Fig. 1(a). These faults can be modeled electrically by a resistor connecting adjacent tracks. Soft Faults: These are generated by defects that do not connect separate electrical nodes but reduce the distance between them as shown in Fig. 1(b). The distance is reduced to such an extent that the defect can be modeled as a leaky capacitor. (Allan -- page 146).

Therefore, Allan discloses that hard and soft faults are both caused by extra material defects. However, Allan does not teach or suggest that such hard and soft faults are caused by non-

transient or transient defects. For example, Allan does not teach or suggest that the hard and soft faults are caused by defects that print under all conditions or only specific conditions.

Third, Allan does not teach or suggest determining soft faults by subtracting out the hard faults as suggested in the Office Action. In particular, Allan states that "The region associated with soft faults alone is generated by subtracting the hard fault critical area from this region as shown in Fig. 3(f)." (Allan -- page 148). In addition, Allan defines the critical area of the layout as the region in which a defect of size x must fall in order to cause a fault (*See*, for example, Allan -- page 146). Therefore, Allan discloses subtracting the hard fault critical area (the region in which a defect of a certain size must fall in order to cause a hard fault) from the soft fault critical area (the region in which a defect of a certain size must fall in order to cause a soft fault). As such, Allan teaches subtracting regions of an integrated circuit layout associated with hard faults from regions of the integrated circuit layout associated with soft faults. However, subtracting regions associated with different kinds of faults is not equivalent to determining soft faults by subtracting out hard faults. Moreover, subtracting regions associated with different kind of faults is not equivalent in any manner to subtracting non-transient defects from aerial images. As such, contrary to the assertions in the Office Action, the combination of Shykind, Ferguson, and Allan does not teach or suggest determining a presence of transient repeating defects on a reticle by subtracting non-transient defects from aerial images of the reticle and comparing at least one pair of the aerial images corresponding to at least two different values of a member of a set of lithographic variables, as recited in claim 20.

Furthermore, none of the other cited art (i.e., Fujimori, Kenan, Sumita, and Shibuya) teaches or suggests determining a presence of transient repeating defects on a reticle by subtracting non-transient defects from aerial images of the reticle and comparing at least one pair of the aerial images corresponding to at least two different values of a member of a set of lithographic variables, as recited in claim 20. Therefore, none of the cited art, individually or in any combination thereof, teaches or suggests all limitations of claim 20.

The Office Action states:

> Shykind et al does not disclose expressly that prior to said determining, preprocessing the at least one pair of the images to remove relatively high intensity values and relatively low intensity values from the at least one pair of the images. Sumita discloses removing dark and bright areas of the image in a preprocessing step (col. 5, lines 8-15)...it would have been obvious to combine the method of Shykind et al (as modified by Ferguson et al) with the removal of dark and bright regions, as disclosed by Sumita to obtain the invention as specified in claim 11. (Office Action -- page 12).

Applicants respectfully traverse this assertion. In particular, Applicants respectfully submit that Sumita is non-analogous art. For example, Sumita discloses methods for inspecting solid bodies that are not analogous to methods for inspecting reticles and detecting defects on reticles. In particular, Sumita states that "The present invention relates to a method of inspecting a solid body for foreign matter, and more particularly to a method of automatically inspecting a solid body such as freeze-dried preparations filled in a vial for foreign matter thereon based on an image of the vial that is produced by an imaging device." (Sumita -- col. 1, lines 7-12). Therefore, the solid bodies that are inspected by the methods of Sumita are substantially different than reticles, and the irregularities in the solid bodies that Sumita teaches renders such solid bodies acceptable would render reticles defective. In particular, Sumita discloses that "It is therefore an object of the present invention to provide a method of inspecting a solid body for foreign matter to differentiate between small pieces on the solid body and surface irregularities of the solid body for rejecting a solid body smeared with small pieces of foreign matter as a defect and passing a solid body with surface irregularities as acceptable." (Sumita -- col. 2, lines 34-40). In addition, Sumita states:

> the level of an image signal which is higher than a predetermined upper limit is set to the upper limit and the level of an image signal which is lower than a predetermined lower limit is set to a lower limit...Accordingly, bright and dark areas produced by surface collapses or cracks are excluded, so that image signals produced by small pieces of foreign matter can be detected with ease. (Sumita -- col. 2, line 59 to col. 3, line 6).

Therefore, the image pre-processing performed by Sumita eliminates signals corresponding to surface collapses and cracks in the cake since as taught by Sumita surface collapses and cracks are acceptable in the cake. However, eliminating such defects from reticle inspection results is disadvantageous since defects such as cracks in a reticle can cause significant defects in wafers printed using the reticle and would therefore be of significant interest to a user of the reticle. As such, eliminating such defects from reticle inspection results would be undesirable. In addition, due to the differences in the solid bodies taught by Sumita and reticles and the differences in the images that would be acquired for the solid bodies taught by Sumita and reticles, it would not have been obvious to one of ordinary skill in the art at the time of the invention to apply the image pre-processing taught by Sumita to images of a reticle. Therefore, contrary to the assertions in the Office Action, it would not have been obvious to combine the method of Shykind et al (as modified by Ferguson et al) with the removal of dark and bright regions as disclosed by Sumita to obtain the invention recited in claim 11.

The Office Action states that "Regarding claim 14, Shykind et al discloses that if more than one anomaly is found in the design pattern, the method further comprises binning the more than one anomaly according to regions of the reticle proximate the more than one anomaly by flagging the defect regions (fig. 8, item 810). This occurs if there is any amount of anomalies." (Office Action -- pages 4-5). Applicants respectfully traverse this assertion. In particular, Shykind states that "The mask defects on a wafer are then sorted from naturally occurring random defects by selecting the detected locations with different wafer patterns (i.e. defects) that only occur on multiple dice (step 808). Finally, at step 810, the multiple defects are flagged as mask defects." (Shykind -- col. 4, lines 52-56). Therefore, Shykind discloses detecting mask error defects by comparing wafer patterns at the same location in multiple dice and sorting random defects on the wafer from the mask error defects based on whether the defects occur on multiple sets of dice (*See also*, Shykind -- col. 2, lines 57-65). However, Shykind does not teach or suggest binning the mask defects in any manner after they have been identified as taught by Shykind. As such, contrary to the assertions in the Office Action, Shykind does not disclose

binning more than one anomaly according to regions of the reticle proximate the more than one anomaly, as recited in claim 14.

The Office Action states that "Regarding claim 15, Shykind et al discloses determining a process window for a lithography process to be carried out using the reticle, the process window being the area of the process for each of the processing conditions (fig. 3)." (Office Action -- page 5). Applicants respectfully traverse this assertion. In particular, Shykind states that "One embodiment of a silicon wafer configuration 300 to detect mask defects is shown in FIG. 3. Each alternating die 302, 304 (in this case, alternating column) is printed with a different process condition. The different condition is selected to highlight defect areas while keeping areas without defects unchanged." (Shykind -- col. 2, lines 42-49). Therefore, Fig. 3 of Shykind illustrates a layout of dies on a wafer and the dies in the layout that are printed using the reticle with different process conditions. As such, Fig. 3 of Shykind illustrates how dies may be printed on a wafer with different process conditions such that the dies can be used to detect defects in the reticle. In other words, Fig. 3 of Shykind illustrates how a lithography process using the reticle for defect detection on the reticle can be carried out. However, Fig. 3 of Shykind does not illustrate determining a process window for a lithography process to be carried out using the reticle. In addition, no other portion of Shykind teaches or suggests determining a process window for a lithography process to be carried out using the reticle. As such, contrary to the assertions in the Office Action, Shykind does not disclose determining a process window for a lithography process to be carried out using a reticle, as recited in claim 15.

The Office Action states that "Regarding claim 16, Allan et al discloses determining a critical status of the anomaly, whether a defect is a hard or soft defect (pg. 3, paragraph 2)." (Office Action -- page 8). Applicants respectfully traverse this assertion. In particular, Allan discloses determining the critical area in a layout of an integrated circuit for hard and soft faults. For example, Allan states that "The sensitivity functions $h_c(x)$ and $h(x)$ can be seen as representing the critical area of the layout, the region in which a defect of size x must fall in order to cause a fault." (Allan -- page 146). However, determining regions in an integrated circuit

layout in which a defect of a certain size must fall in order to cause a fault is clearly not equivalent to determining a critical status of an anomaly on a reticle. Therefore, contrary to the assertions in the Office Action, Allan does not teach or suggest determining a critical status of an anomaly, as recited in claim 16.

The Office Action states that "Regarding claim 26, Allan discloses the non-transient defects comprise reticle manufacturing errors such as faults that cause shorts (g. 1, pp. 7), shorts being errors that are manufactured from a mask (abstract)." (Office Action -- page 8). Applicants respectfully traverse this assertion. In particular, Allan states that "Extra material defects cause circuit faults which can be classified as one of two types [2]: Hard faults: These are faults which cause a short between two separate electrical nodes as shown in Fig. 1(a)." (Allan -- page 146). Therefore, Allan discloses that shorts are caused by extra material defects on a wafer. However, Allan does not teach or suggest the cause of such extra material defects. In particular, Allan does not teach or suggest that such extra material defects are caused by reticle manufacturing errors or contaminants on a reticle. Therefore, contrary to the assertions in the Office Action, Allan does not teach or suggest that non-transient defects include reticle manufacturing errors such as faults that cause shorts or that shorts are errors that are manufactured from a mask. As such, Allan does not teach or suggest that non-transient defects detected on a reticle include reticle manufacturing errors or contaminants on the reticle, as recited in claim 26.

For at least the reasons stated above, independent claims 1, 17, and 20, as well as claims dependent therefrom, are patentably distinct over the cited art. Accordingly, removal of the § 103 rejections of claims 1 and 3-26 is respectfully requested.

Patentability of the Added Claims

Claims 27-28 have been added. Support for the limitations of claims 27-28 can be found in the Specification as originally filed, for example, on page 21, lines 17-23. Therefore, claims 27-28 do not present new matter. Claims 27-28 are dependent from claim 1, which is patentably distinct over the cited art for at least the reasons set forth above. Therefore, claims 27-28 are patentably distinct over the cited art for at least the same reasons. Accordingly, entrance and allowance of claims 27-28 are respectfully requested.

CONCLUSION

This response constitutes a complete response to all issues raised in the Office Action mailed June 15, 2007. In view of the amendments and remarks presented herein, Applicants assert that pending claims 1 and 3-28 are in condition for allowance. If the Examiner has any questions, comments, or suggestions, the undersigned earnestly requests a telephone conference.

The Commissioner is authorized to charge any fees, which may be required, or credit any overpayment, to deposit account number 02-0393.

Respectfully submitted,

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